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Intraaortic Balloon Pumping Assist Following Open Heart Surgery for Coronary Artery Disease

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Intraaortic balloon pump (IABP) assist was employed in 36 patients after surgical operation for coronary artery disease. In 31 patients, the aid of IABP was required because cardiopulmonary bypass could not be terminated without it. In three of these patients, IABP assist was started before the surgical procedure because these patients were in cardiogenic shock due to myocardial infarction. In the remaining five patients, IABP assist was applied for refractory cardiogenic shock in the early postoperative period.

The overall survival rate was 58 percent. IABP assist was used in 13 patients with an ejection fraction of 0.1 to 0.2 (normal 0.7). Nine of these patients survived.

From our experience, it would appear that this temporary mechanical circulatory support provides a significant advantage in saving patients who might otherwise die after surgical procedures involving the coronary artery.

INTRAAORTIC BALLOON PUMP (IABP) assist has been employed for the treatment of cardiogenic shock secondary to acute myocardial infarction.¹ It augments myocardial perfusion and decreases the left ventricular afterload. This device has also been used for the treatment of intraoperative myocardial failure following cardiopulmonary bypass.

The purpose of this study is to review our clinical experience with 36 patients supported with IABP assist following surgical procedures on the coronary artery.

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Material and Method

From May 1972 to March 1975, myocardial revascularization was carried out in 1,479 patients. The intraaortic balloon pump was used for 36 of these patients before or following coronary artery surgical procedures. These patients were divided into two groups.

Group I consisted of 31 patients in whom IABP assistance was used following surgical operation because of inadequate circulation on termination of cardiopulmonary bypass. IABP assist was initiated before operation in three of these patients who were in cardiogenic shock due to acute myocardial infarction.

Group II consisted of the remaining five patients in whom IABP assist was required for refractory cardiogenic shock in the early post-

INTRAAORTIC BALLOON PUMPING

TABLE 1.—Preoperative Status of 36 Patients

	Patients	Deaths
Coronary artery disease with or without poor ejection fraction	19	8
Complications secondary to acute myocardial infarction	7	1
Unstable anginal syndrome	7	4
Acute myocardial infarction with cardiogenic shock	3	2
TOTAL	36	15
<i>Left Ventricular Impairment</i>		
Ejection Fraction		
0.2 or less	13	4
0.25 to 0.7	23	11
TOTAL	36	15

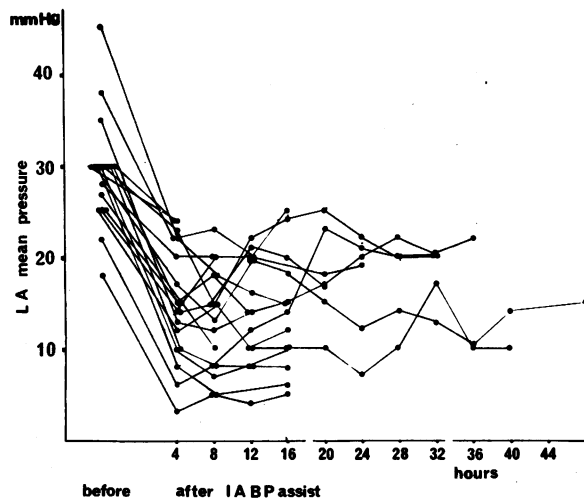


Figure 1.—The serial changes of the mean left atrial pressure during intraaortic balloon pumping (IABP) assist.

operative period, from five hours to two days following return to the intensive care unit. In all of the patients coronary arteriography and left ventricular evaluation were done preoperatively. The ejection fraction was calculated from end diastolic and end systolic volumes, which were obtained by the area-length method of Sandler and Dodge.²

Surgical operation in all patients was carried out by means of cardiopulmonary bypass using the profound hemodilution technique as reported previously by Zubiate and co-workers.³ In 27 patients myocardial revascularization alone was carried out. In seven patients surgical procedures for complications of myocardial infarction were done with myocardial revascularization and in two there was aortic and mitral valve replacement for rheumatic lesions with myocardial revascularization.

The intraaortic balloon pump assist was employed if an adequate circulation could not be obtained when cardiopulmonary bypass was terminated. In Group II the indication for IABP in the early postoperative period was that adequate circulation could not be maintained and the mean left atrial pressure was greater than 25 mm of mercury and the systolic arterial pressure was below 60 mm of mercury despite medical treatment.

The AVCO-IABP system was used in all patients with an average assist of 41 hours, ranging from 15 to 120 hours. Heparin was administered to all patients while on IABP assist, keeping the coagulation time within a range of 15 to 30 minutes. Weaning was accomplished by decreasing the time interval of inflation according to the stability of the clinical finding, blood pressure, left atrial pressure and urine output.

Results

Of the 36 patients in whom IABP assist was applied, 21 survived and were discharged for an overall survival rate of 58 percent.

Of the 31 patients in whom IABP assist was required following cardiopulmonary bypass (Group I), 19 were weaned from IABP. Of five patients who were supported with IABP assist because of refractory cardiogenic shock in the early postoperative period (Group II), three were successfully weaned. One patient died of documented myocardial infarction 11 days after satisfactory cessation of IABP assist.

The preoperative status and the results in the 36 patients are shown in Table 1. Except for the death of one patient due to uncontrollable bleeding while receiving IABP assist, no other major complications could be directly related to IABP assist.

Figure 1 shows the pronounced changes in mean left atrial pressure during IABP assist. Of the 23 patients in whom there was successful IABP assist following cardiopulmonary bypass, left atrial pressure measurements were available in 17 patients. In these patients left atrial pressure decreased significantly in the early period after employment of IABP.

Discussion

Intraaortic balloon pump assist was initially employed for mechanical circulatory aid in the treatment of cardiogenic shock due to acute myocardial infarction. This modality has also

been employed for support following open heart surgical procedures.⁴⁻⁷ There have been a number of reports on IABP assist for intraoperative myocardial failure following cardiopulmonary bypass.⁴⁻⁷ In 1973, Buckley and associates⁴ reported on a series of 26 patients requiring IABP assist following elective cardiac surgical operation, including operation for valvular heart disease. Seventeen were successfully weaned from IABP assist. In 1973, Berger and associates⁵ also reported that 6 of 14 patients survived with the aid of IABP assist following surgical procedures. In our series of 36 patients requiring IABP assist following surgical operation or in the immediate postoperative period, 21 patients survived and were discharged home for an overall survival rate of 58 percent. There was only one late death following successful termination of IABP assist. These results are similar to the reports of others who noted that IABP assist provided time for recovery of depressed left ventricular function due to intraoperative myocardial injury with augmentation of myocardial perfusion and decrease in left ventricular afterload.

Of the present series of 36 patients, in 13 there were extremely poor ejection fractions of 0.1 to 0.2. Nine (69 percent) of these 13 patients survived with the aid of IABP assist. However, only 11 of 23 of the patients with a better ejection fraction of 0.25 to 0.70 survived with the assist device. The explanation for this is not readily apparent, but most likely is as follows. For patients with an ejection time of 0.1 to 0.2 a surgeon is more inclined to use the device sooner since the margin of success in these critically ill patients is so very low. With the first failure to come off bypass, the device is employed in these critically ill patients; whereas, with a better ejection fraction, one continues to attempt to come off bypass and only after many repeated failures is the IABP employed. By this time, the heart has suffered so much injury that the chance of success

with the IABP assist device is decreased to a pronounced degree even though the ejection fraction was better before surgical operation.

In three patients, IABP assist was unsuccessful because of intractable ventricular tachyarrhythmia. Sehapayak and associates⁸ reported three patients in whom IABP assist was applied in an attempt to treat recurrent ventricular tachyarrhythmia. They suggested that IABP assist was ineffective in controlling this type of arrhythmia. In the report by Berger and associates, there were four deaths due to uncontrollable ventricular arrhythmia.⁵

Anticoagulant therapy was used in all patients. One patient in our series of 36 died from uncontrollable bleeding in the early postoperative period. We encountered no significant complications directly related to IABP assist in the other 35 patients.

During our initial experience the mortality rate was high, but this has improved recently. From our experience it is imperative that in order to obtain more successful results, IABP assist should be instituted without delay, now that its safety and efficacy in supporting the circulation has been well established.

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